Mechanical & Integration
WBS 1.1 & 1.10
Plenary Session

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Corrections 30Mar04:
added missing S. Toroid
corrected 2.0 & 3.0 on responsibility table
added RICH BP needed 2008

Outline

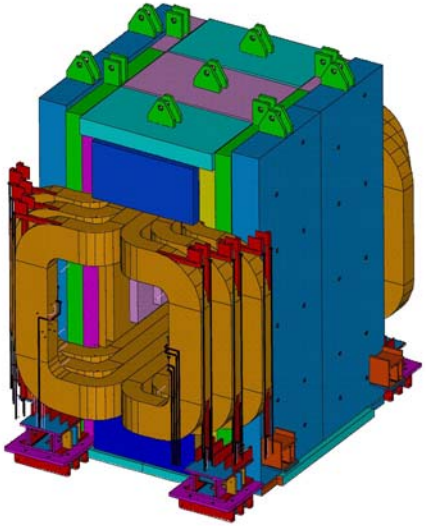
- WBS 1.1 Vertex and Toroid Magnets and Beam Pipe
  - Component Description
  - Cost Information
  - Schedule Information
- WBS 1.10 Installation, Integration and Commissioning
  - The Organization and Scope of WBS 1.10
  - Coordination with subproject and WBS 2.0 and 3.0
  - Overall Layout of Detector & C0 Building
  - Detector Characteristics
  - Schedule Information
  - Cost Information
- Summary

Vertex Magnet (WBS 1.1.1)

- Characteristics
  - Disassembly and rebuild of SM3 (E-605)
  - New pole inserts and new features for rolling into collision hall
- Cost Summary

  Total → 581K$ construction + 148k$ cont. (25%)
  - 45K$ - Design
  - 368K$ - Procurement (disassembly + transport)
  - 167K$ - reassembly + testing
- Schedule Summary
  - Forward loaded for early installation
  - Ready for installation 2006
  - Critical Path: new pole insert iron, assembly hall availability

Note: FY05 $ Fully Burdened

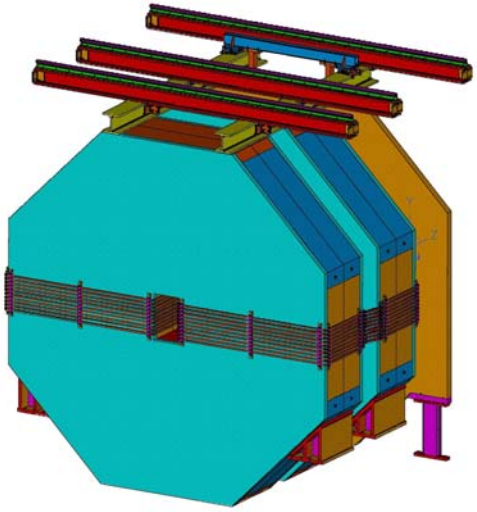


Toroid Magnets (WBS 1.1.2)

- Characteristics
  - Recover and rework SM12 Iron
  - New coils on both pairs of Toroids
  - Muon support features on North Toroid only
  - Features for rolling into collision hall and supporting
- Cost Summary

  Total → 831K$ const. + 232K$ cont. (28%)
  - 47K$ - design
  - 560K$ - procurement
  - 224K$ - assemble & test
- Schedule Summary
  - Forward loaded for early installation
  - 1st Toroid pair ready for installation 2006
  - 2nd Toroid pair ready for installation 2007
  - Critical Path: additional iron, new coil

Note: FY05 $ Fully Burdened



Beam Pipe (WBS 1.1.3)

Characteristics

- Reworked CDF run 2b Beryllium beam pipe in forward tracking region
- Reworked CDF run I Beryllium beam pipe through RICH Detector
- Conventional beam pipe sections (initial pipe provided by WBS 2.0)

Cost Summary

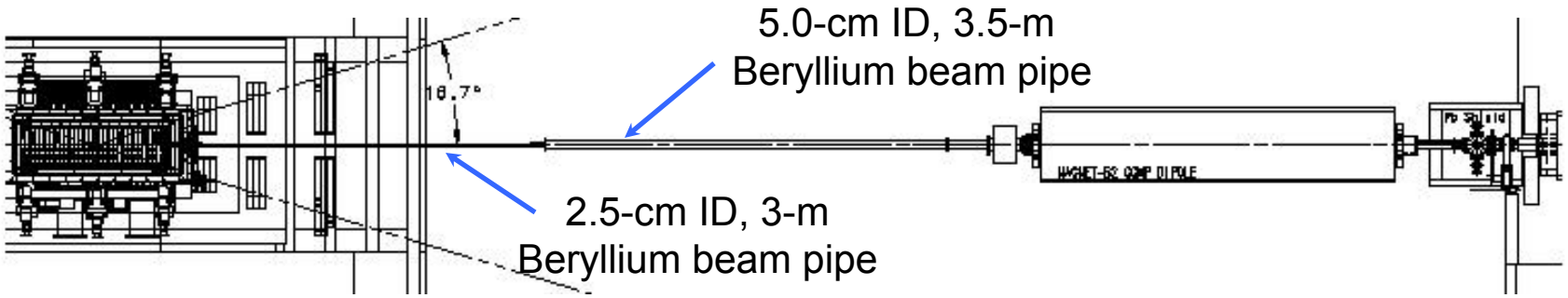
Total → 303K$ const. + 50K$ cont. (17%)

- 76K$ - design
- 202K$ - procurement
- 25K$ - assemble & test

Schedule Summary

- Parts acquisition delayed to match funding profile
- Critical Path: development of low mass flanges

Note: FY05 $ Fully Burdened



WBS 1.10 Structure

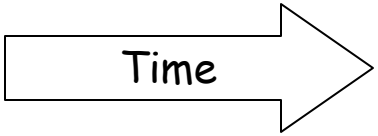
1.10.1 System Installation, Integration, Testing and Commissioning Planning

1.10.2 Infrastructure Development and/or Procurement, Installation and Testing at C0

1.10.3 Component and System Transportation to and Assembly, Installation and Infrastructure Connections at C0

1.10.4 Stand-Alone Subsystem Interconnections and Integration and Testing at C0

1.10.5 Multiple Subsystem Interconnections and Integration and Testing



1.10.6 System Integration and Testing

1.10.7 System Installation, Integration and Commissioning Subproject Management

Overall Scope

- 1.10.1 Planning
  - Multi-system coordination
    Overall drawings, numbering systems, cable and rack plans
  - Documentation and ES&H guidance
    General, stand-alone & multi-system installation and operating procedures

- 1.10.2 Infrastructure and common procurement
  - Electrical Infrastructure
    - Coordination with WBS 3.0
    - Racks and rack protection
    - Power distribution from panels to racks
    - Cable trays and access platforms
  - Mechanical Infrastructure
    - Electronics cooling water supply and distribution
    - Dry air, nitrogen and argon supply
    - General installation equipment
  - Common procurements
    - Procurement coordination effort for high voltage and low voltage power supplies and cables
    - Note: material costs are in detector subproject WBS

Overall Scope

- 1.10.3 Transportation, Assembly and Installation
  - Transportation costs to C0 Building
  - Installation labor for individual detectors and systems at C0
    - Place detector and support systems
    - Detector-to-rack cable routing and utility routing
    - Survey and Alignment
    - Installation of cables in cable trays and Collision Hall Racks
- 1.10.4 Stand-alone system interconnections and testing
  - Complete connections and test mechanical systems
  - Complete connections and test electrical systems
- 1.10.5 Multi-systems interconnections and testing
  - Connect all detectors to DAQ and test
  - Interconnect and test Trigger, DAQ, Pixel and Muon
- 1.10.6 System integration and testing
  - Test all timing, control and data links
  - Verify that systems are ready for beam

The function of WBS 1.10

- Needs that are addressed by WBS 1.10
  - Project is too large to use a single project management file to schedule all activities.
    - Need to allow sub-projects to work on project plans in parallel
    - Need a way to connect the terminal activities of all sub-project groups
  - The C0 building is small and space management is important
  - Many activities are done more efficiently in a coordinated way
    - Common infrastructure
    - Common installations
    - Common procurements
- How WBS 1.10 will work
  - 1.10 does some semi-autonomous tasks like infrastructure
  - 1.10 is primarily an organization structure for planning tasks
  - Most of the effort in 1.10 comes from the subproject groups
  - Subproject groups will be involved in all phases of 1.10
  - WBS 1.10 functions like a militia

WBS 1.10 communication with sub-projects

- Requirements tables i.e. Heat Loads, Racks, Power Supplies, Cables
- Producer schedule milestones lists
  - Limited number of key milestones for equipment delivery
  - Will be implemented in RLCS to connect subprojects to each other and to installation
- Sub-project installation, integration and testing plans
  - Prepared by each subproject group
  - Describe the work and provide estimates of the manpower for installation, integration and testing
  - Define boundaries of responsibility between the subproject and WBS 1.10 i.e. Partial assembly in the collision hall
  - Provides a tool for sharing ideas between subprojects
- Task forces to address issues that require coordinated solutions
  - Cable Plant •Racks and Grounding • Slow Controls
  - Survey and Alignment • Equipment ID and numbering systems
  - Beam Loss

  Fosters collaborative teaming outside the subproject boundaries

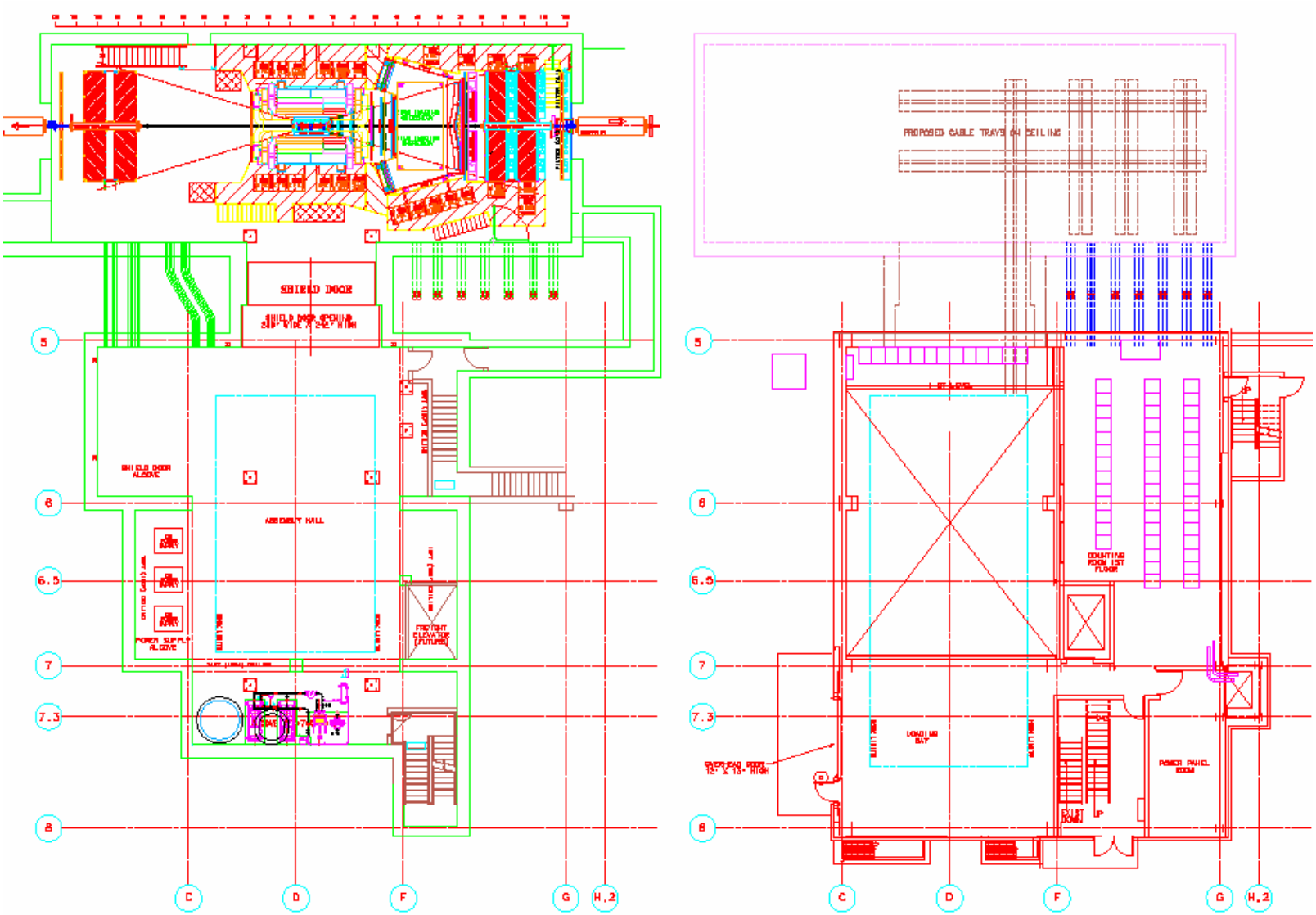
WBS 1.10 interfaces with 2.0 & 3.0

- Space/Schedule issues are very manageable (more later)
- Infrastructure and equipment responsibility is a little complicated
- Considerations in determining the responsible group
  - Who can do it most efficiently ?
  - Does it depend heavily on the details of the detector?
- Requires timely and thorough definition of requirements
- Partial list of requirements that have been exchanged
  - Electrical infrastructure at C0 document
  - Detector power and heat loads table
  - Magnet LCW requirements document
  - ODH ventilation requirements document
  - Detector backup power requirements
- Requirements have been stable
- Communication has been good

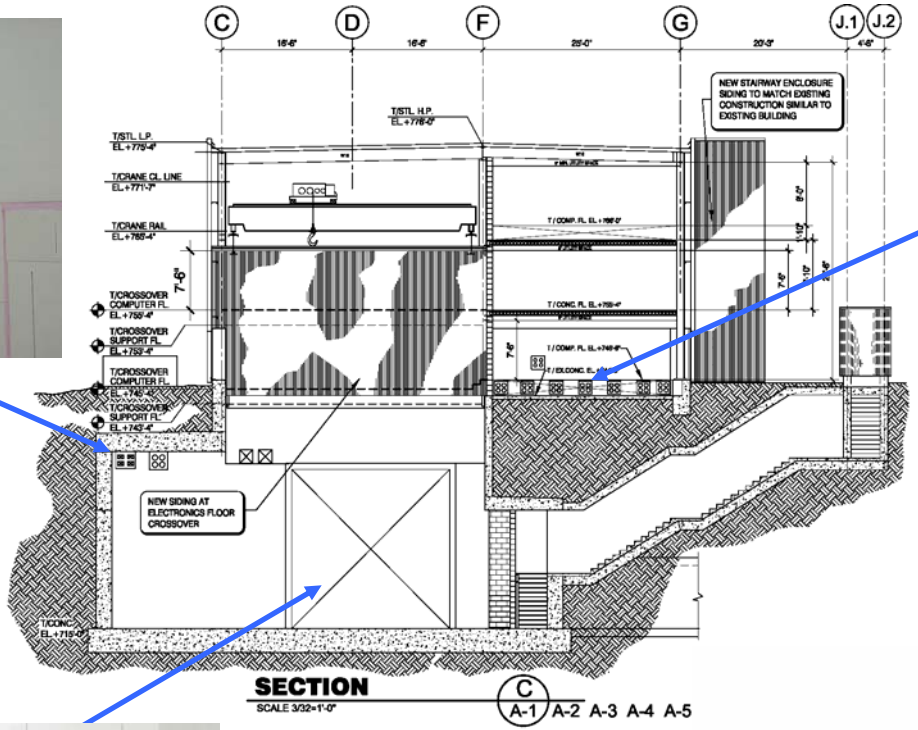
Division of Responsibility

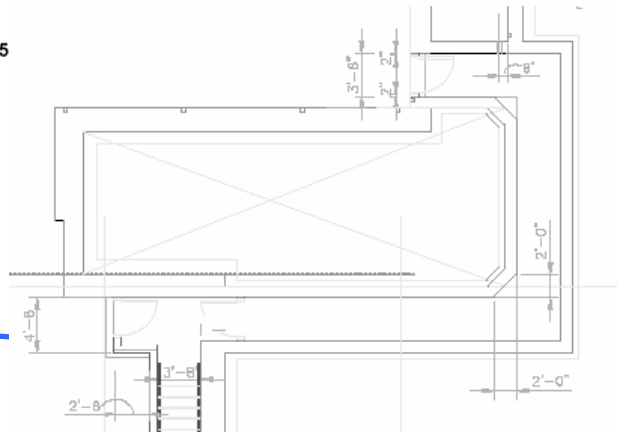
Item	WBS 3.0	WBS 1.10	WBS 2.0
Power	Shielded transformers for collision hall and counting rooms. Breaker panels in each major building section.	Power distribution to racks and detectors	
Backup power generator & UPS	Complete	None	
LCW		Connections including bus from header to Magnets & PS	Headers with valves along walls in Collision and Assembly hall
Chilled Water	Complete	None	
Third floor counting room cooling	Complete	None	
First floor and collision hall rack cooling	Chilled water for ECW. Headers under 1st floor of counting room	Electronics cooling water system and distribution manifold	
Fire detection system	Room monitors in Collision, Assembly halls and Counting rooms	Smoke detection as part of rack protection	
Counting Room Ground Plane	Complete	None	
Collision Hall Ground Plane	None	Complete	
Large Shield Door Operation		2006-2009 shutdowns	2005 shutdown only
ODH Barrier at Tunnel/Hall		None	Complete
Gate Valves & Instrumentation		Instrumentation and pumps	Gate Valve at low Beta Quad
Beam Pipe		Final pipes	4" pipe at 2005 shutdown

C0 Building


SHIELD DOOR
ASSEMBLY HALL
PROPOSED CABLE TRAYS ON CEILING
LOADING BAY
POWER PANEL ROOM
5
6
6.5
7
7.3
8
C
D
F
G
H.2

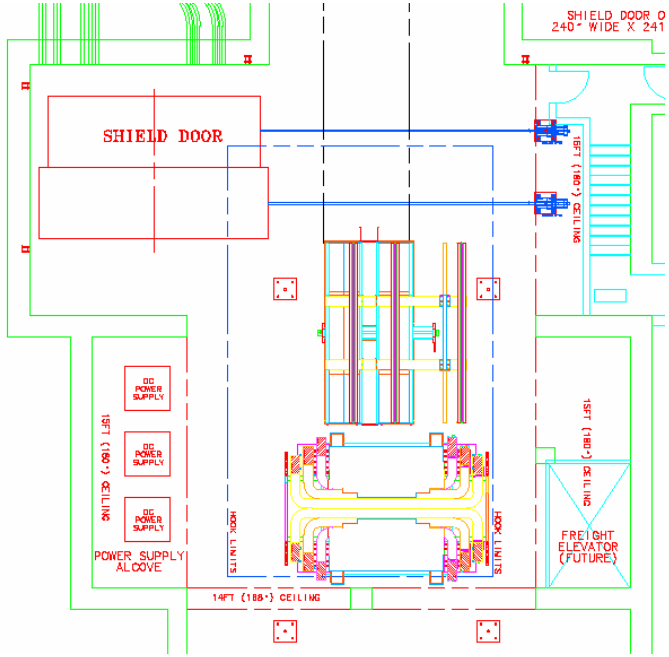
Collision Hall Penetrations





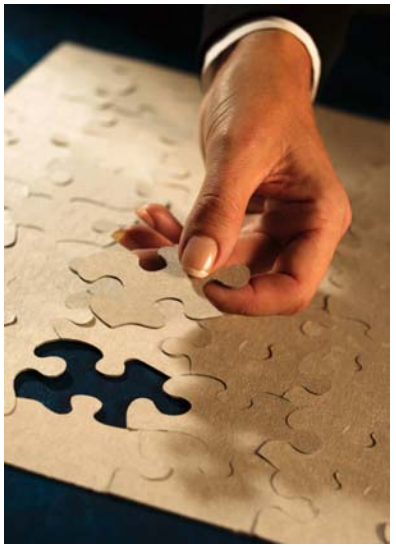
Vertex & Toroid Magnets Installation

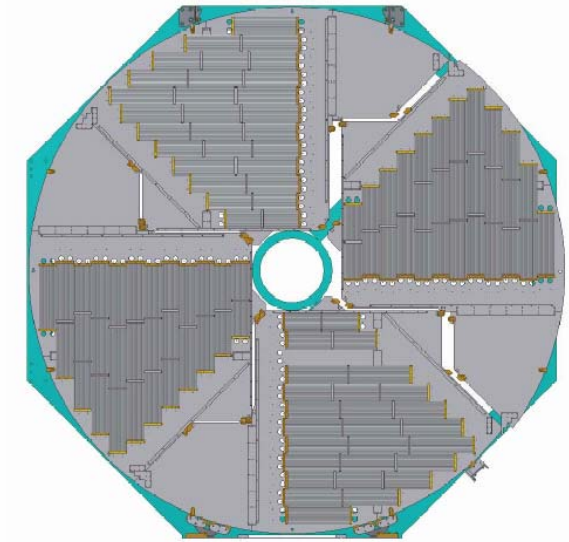
- Characteristics
  - Massive (~400 Tons each)
  - Only 2 fit in the assembly hall at one time
  - The foundation for other detectors
- Schedule Notes
  - Need access to C0 building for assembly
  - Need LCW and power for testing
    - LCW from WBS 2.0
    - Power from C0 outfitting Phase 1
  - Need to move them into the collision hall to clear assembly hall for later detectors
    - South Toroid and Vertex Magnet in 2006 shutdown
    - North Toroid in 2007 shutdown



ECAL and Muon Detector Installation

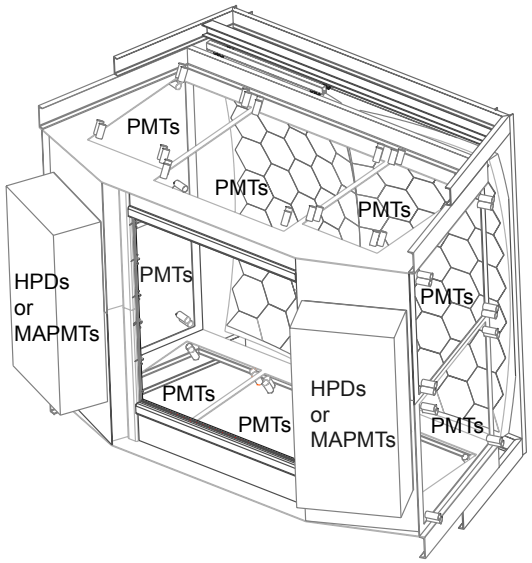
- Characteristics
  - Multi-part (10K Crystals, 24 Muon Wheels)
  - Generally independent of other detectors
  - Component availability phased over 2+ years
- ECAL Schedule Notes
  - Support structure assembled in collision hall along with RICH after 2nd Toroid is installed
  - Partially filled support structure installed in 2008 shutdown
  - Crystal availability is spread from late 2007 until 2009
- Muon Schedule Notes
  - Requires Toroid Magnet
  - Some Muon Wheels will be installed on North Toroid before 2007 shutdown
  - The balance installed in the collision hall as "knitted" plate segments on rollers
  - Wheel availability is spread from 2006 until 2008





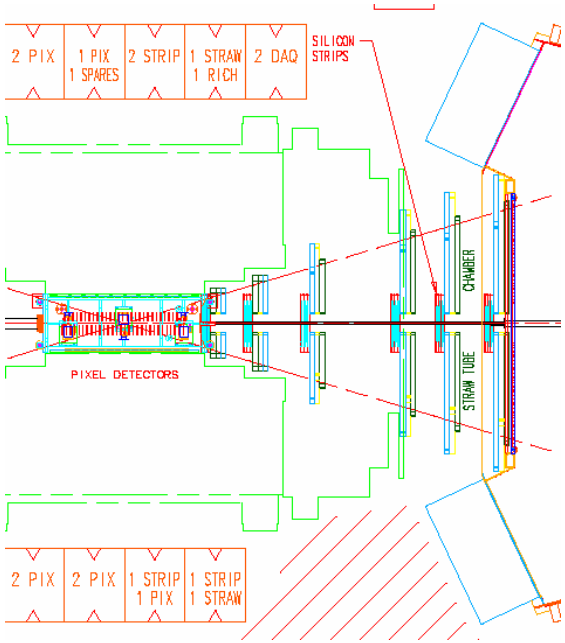
RICH Installation

- Characteristics
  - Large (does not fit past Vertex Magnet with MAPMT array's in place)
  - Many features (Mirrors, liquid radiator, MAPMT's, PMT's)
  - Be beam tube section passes through RICH
- Schedule Notes
  - RICH Tank assembly must take place in C0 Assembly hall
  - RICH Tank with mirrors is installed in 2008 shutdown
  - Several mirror installation/alignment scenarios are possible
  - Final RICH components available in early 2009



Pixel and Forward Tracking Installation

- Characteristics
  - Light to moderate weight (few to 1000 kg)
  - Very delicate
  - Congested Installation
  - ~8K cables plus cooling & dry purge lines
- Installation Sequence
  - 1st Pixel detector
  - 2nd Forward tracking beam pipe
  - 3rd Straw and Strips (6 Stations)
- Schedule Notes
  - Pixel detector and straw stations available in early 2009



Installation Schedule

	Collision Hall	Assembly Hall	Counting Rooms	Tev. Tunnel
Summer 2005 Shutdown	Remove Magnets Install LCW lines	Install LCW lines		Reconfigure for C0 straight
Fall 05 – Summer 06		Install power for magnet Assemble and test Vertex Mag. & 1st Toroid	Install structural, floors and block wall	
Summer 2006 Shutdown	Install power for racks Install Vertex Mag. & 1st Toroid			
Fall 06 – Summer 07		Assemble 2nd Toroid Begin RICH assembly	Finish counting rooms Finish building power	
Summer 2007 Shutdown	Complete & commission HVAC Install 2nd Toroid Install partial Muon			Begin installing low Beta Quad buswork
Fall 07 – Summer 08		Assemble ECAL structure Continue RICH assembly	Install racks	
Summer 2008 Shutdown	Install partially filled ECAL Install RICH with Mirrors			Remove Q1 magnets and P spool Continue buswork
Fall 07 – Spring 08		Stage Pixel & Tracking	Finish Trigger & DAQ	
Summer 2009 Shutdown	Install Pixel & Tracking Finish: RICH, ECAL, Muon			Install new IR components

Detector Schedule Notes

- General Themes in Detector Installation
  - Need to complete the magnets and install them to clear space in the assembly hall for following detector assembly
  - Particle ID detectors (RICH, ECAL & Muon) assembly and installations have the most flexibility
  - The Pixel detector and Forward Tracking must be installed in the final extended shutdown because of the nested nature of these detectors
  - Need to accomplish as much work as possible prior to the last shutdown to be able to focus on the Pixel and Forward Tracking
- Considerations from Building Outfitting Schedule
  - Phase I: Structural for counting rooms and test power for magnet
    - Completes heavy construction where access to assembly hall is needed
    - Provides power for vertex magnet testing
  - Phase II: Counting room finishes, complete power, complete mechanical
    - Collision and assembly hall work occurs during the flexible detector installation period
    - Timing matches Trigger and DAQ decisions and installation
- Considerations from IR Installation Schedule
  - Conversion to C0 straight clears the collision hall
  - Provides the LCW for magnets
  - Major work in final shutdown to install new IR coincides with most intense work of detector installation

WBS 1.10 Costs

Activity ID	Activity Description	Duration	Material & Services Cost	Labor Cost	Base Budget	Labor Contingency ($)	Materials & Services Contingency ($)	Total Budget (Base + Contingency)
CONSTRUCTION								
			$1,912,328	$4,932,568	$6,844,896	$3,085,559	$407,522	$10,337,978
1 -- Installation, Integration, Testing and Commission Planning								
			$0	$433,745	$433,745	$153,308	$0	$587,053
2 -- Infrastructure Development + Procurement, Install+Test at C0								
			$1,575,932	$1,135,247	$2,711,180	$378,357	$337,271	$3,426,809
3 -- Component and Syst Transport, Assembly, Install, and Connect								
			$165,801	$1,576,339	$1,742,140	$1,119,919	$70,250	$2,932,310
4 -- StandAlone Subsys Interconnection, Integrat + Testing at C0								
			$63,800	$784,947	$848,747	$784,947	$0	$1,633,694
5 -- Multiple Subsys Interconnect and Int +Testing at C0								
			$29,000	$560,711	$589,711	$560,711	$0	$1,150,423
6 -- System Integration and Testing								
			$29,000	$0	$29,000	$0	$0	$29,000
7 -- System Install Integrate Commission Subproject Management								
			$48,794	$441,577	$490,371	$88,315	$0	$578,687
8 -- BTeV Project Level 1 Milestones								
			$0	$0	$0	$0	$0	$0

Note: FY05 $ Fully Burdened

Summary

- Vertex and Toroid magnets are conventional and their costs are well understood.
- Need to build early to clear the hall for following detectors
- RICH Beam pipe needed 2008, Forward Tracking BP needed 2009

- Extensive coordination has taken place between Detector Installation, Building Outfitting and C0 IR on Schedule and Infrastructure
- WBS 1.10 has been reorganized to accomplish more coordinated activities
- Sub-detector installation activities are being rewritten to match installation, integration and testing plans developed by sub-detector groups
- Characteristic of the Detectors drive the installation sequence
- Installation plan has been revised to reflect annual shutdowns
  - Detector installation plan fits well with Building and IR plans
  - Setup for final shutdown with Pixel and Forward Tracking installation is the key
  - Prior steps have some flexibility but they must be accomplished before final shutdown